MQA-10: OPD #3 – CAS WEAPONS

PREREQUISITES: MQA-9

REQUIRED READING: JP 3-09.3; TO 1M-34; AFFTP 3-1 Vol 26 (ASOC & TACP Operations) Chapter 6

PURPOSE: Familiarize new ALO with Officer Professional Development briefing on CAS weapons.

Introduction - (Slide 2)

This class provides the student with knowledge of USAF aircraft weapon characteristics, capabilities and limitations. The list of U.S. Air Force weapons includes guns, general purpose (GP) bombs, precision guided munitions (PGMs), cluster munitions, and air-to-ground missiles (AGMs). Realize that this is a lesson given to the Army and they won't care about all the weapons discussed in this lesson. The hidden slides are for ALO information and only if the Army has questions about them. Topic covered will be:

- Weapons Effects
- Air to Surface Guns
- General Purpose Bombs
- Precision Guided Munitions (PGM) and Designation Systems
- Cluster Munitions
- Risk-Estimate Distances
- Targets/Weapons Summary (Inventory Weapons Only)
- Additional Weapons Information

* Marterial taken from Joint Fire Control Course (JFCC) paper

Weapon Effects – (Slide 3)

Fragmentation Produces shrapnel to kill people and destroy soft targets (like trucks).
Blast Destroys objects through overpressure. Great for non-hardened buildings, producing concussion for crews inside tanks, and troops in the open. Bombs set to explode above the ground at a certain altitude produce a great deal of blast from the overpressure if it matches the mach wave.
Incendiary Sets things on fire.
Penetration Penetrates and destroys people/things inside hardened targets, like aircraft inside concrete hangers; troops inside a command bunker.
Anti-Personnel Good against troops in the open.
Anti-Armor Designed to penetrate the armoron tanks.

Circular Error Probability (CEP) is a term used by the Air Force to describe the accuracy of a weapon system. A CEP of 8 meters means that half the bombs will fall within 8 meters of the desired impact point, and half the bombs will fall outside of 8 meters.

Weapons are designed to go against different target types. A point target is a target located at a specific spot, generally a high value target like a command and control bunker. An area target is spread over a wide area, like a column of tanks, or spread out infantry. Some weapons are designed to have a large area of impact.

Air To Surface Guns – (Slides 4 – 6)

The gun is an accurate, responsive, reliable, and flexible weapon. In general it can be used closer to friendlies than General Purpose (GP) bombs or Cluster Bomb Units (CBUs). Guns are generally only effective against soft targets and personnel, except for the GAU-8 which fires shells that can penetrate armor:

M6l Vulcan:
- 20 mm gatling gun found on all primary fighters except the A-l0
- Fires 6,000 rounds per minute
- 6 barrels

GAU-8 Avenger:
- 30 mm gun found on the A-l0 only
- High muzzle velocity with excellent energy retention at greater distances than 20 mm
- Large ammunition capacity with rounds designed for armored vehicles
- Fires 3,900 rounds per minute
- 7 barrels
- 1174 rounds, approximately 10 burst

Guns of the AC-130 (next slide):

AC-130H: Employs an array of cannons to include:
- One slewable 40 mm BOFORS M2A1 cannon located on the port side just aft of the wing
  - Fires 100 rounds per minute
  - Can carry 256 rounds or 416 rounds.
- One slewable 105 mm M102 cannon similar to the US Army Howitzer located on the port side just aft of the BOFORS 40 mm
  - Fires 6 - 8 rounds per minute
  - Can carry 100 rounds
  - Fuses are point detonate, delay, and proximity fuses for airbursts (anti-personnel) (next slide).

AC-130U: Newest version of AC-130 with an APG-70 pulse-Doppler fire control radar for all-weather employment. Employs an array of cannons to include:
- One 25 mm GAU-12/U gatling gun located on the port side just aft of the flight deck
  - Fires 5000 rounds per minute
  - Can carry up to 3000 rounds
- One slewable 40 mm BOFORS M2A1 cannon located on the port side just aft of the wing.
  - Fires 100 rounds per minute
  - Can carry 256 rounds or 416 rounds
- One slewable 105 mm M102 cannon similar to the US Army Howitzer located on the port side just aft of the BOFORS 40 mm
  - Fires 6 - 8 rounds per minute
  - Can carry 100 rounds
  - Fuses are point detonate, delay, and proximity fuses for airbursts (anti-personnel)

General Purpose Bombs – (Slides 7 – 8)

- Most common bomb; cheap, simple and versatile. In the past, GP bombs were not very accurate, but they have improved with technology.
- Can be dropped one or more at a time. Primarily an area weapon since there is no terminal guidance to hit a "point" target. However, current weapon systems (F-16, F-15E, A-10) have very accurate delivery systems that improve GP bomb accuracy. Current Circular Error Probability (CEP) for visual deliveries are around 20-50 meters depending on delivery profiles. Again, CEP means half the bombs will fall within the specified distance, and half will fall outside the specified distance.
- GP bombs produce a combination of blast, fragmentation, incendiary and penetration effects. Blast, fragmentation, and penetration are the primary effects. The effects are decided by a combination of bomb body, and fuzing.

- The most common general purpose bombs are the Mark 80 series. Bomb sizes are: the MK 81, 250 lb. bomb; the MK 82, 500 lb. bomb; the MK 83, l000 lb. bomb; the MK 84, 2000 lb. bomb. Other bombs include the M-117, a 750 lb. bomb, is used primarily by B-52s and B-1s and the BLU-109 or I-2000 improved 2000 lb bomb, which has a thicker case for better penetration (also available for use with precision guidance control kits). The Navy uses MK-83s a lot because of the way storage space is arranged on the carrier, and because of landing weight restrictions on aircraft carriers (next slide).
- GP bombs are available in 2 fin configurations, slick or high drag. High Drag or Air Inflated Retard (AIR) kits enable bombs to be dropped at lower altitudes (closer to the target) for greater accuracy, in level or shallow dive angles, and allow the aircraft "safe escape" from their fragmentation. The designation for a MK-82 with AIR is BSU-49 and for a MK-84 with AIR the designation is BSU-50. The fragmentation envelope for different bombs and munitions can be found at the tables at the end of this lesson. The frag envelope for a MK-82 dropped at Sea Level is 2140' high, 2550' wide, and 24.4 seconds. Those numbers mean an airplane at those distances from the bomb explosion has less than a 1/1000 chance of getting hit by the bomb fragments. The frag cloud will last 24.4 seconds from the bomb explosion. Those frag numbers don't take into account the 2 lug nuts which can go anywhere.
- Often configured with 2 fuses, a nose and a tail fuse, which may be cockpit selectable and may have different settings.
- The typical fuse settings are: instantaneous (for fragmentation and blast), or delay (for penetration). Proximity fuses are on CBUs to set pattern size and density, and to produce frag and blast effects on GP bombs.
- They can be fitted with steel nose plugs to allow for greater penetration against hardened targets. The MK 36 Destructor is a MK-82 High Drag (Snakeye) fitted with a MK 75 arming kit which converts the bomb into a land or water mine for area denial purposes.
- The BLU-82 is a 15,000 lb GP bomb dropped by C-130s. It produces a lot of blast and can clear helicopter landing zones .

Precision Guided Munitions (PGM) And Designation Systems – (Slides 9 – 16)

Maverick (AGM-65)
- A 500 lb. class rocket-propelled munition compatible with F-16, A-10, F-15E, F-4G and Navy/Marine attack aircraft.
- The A, B, and D models have a 125 lb. shaped charge warhead. The E, F, and G models have a 300 lb. fragmentation warhead.
- The A&B models (TV) are not effective at night. The D, F, & G (IR) models have day/night good weather capability. The E model (Laser) is used by the Navy and Marine Corps and has day/night good weather capability.
- The K Model is a retrofit of the A and B model with a bigger warhead and improved TV camera. This model is presently in development.
- The combination of self-contained guidance and boosting provides a standoff launch and leave capability (except for the laser guided version which requires an air or ground designator) (next slide).

Laser Guided Bombs (LGB)
- Laser guidance kits attached to MK-82 = GBU-12, MK-84/BLU-109 = GBU-10, MK-84/BLU-109 = GBU-24 (low level LGB), and BLU-113B (4500 lb.) = GBU-28.
- Provide for pinpoint accuracy against "point" or "single" targets.
- Good day or night but in good weather only. Can't guide LGBs through clouds.
- The LGB's effect is the same as the bomb the guidance kit is attached to. Just like for GP bombs, the effect is determined by the bomb body and fuzing.
- The range of an LGB depends on how fast the aircraft is flying, the altitude the bomb is released, and the aircraft's release angle. Generally, the range is around 3 miles at low altitude, and 5 miles at medium altitude (next slide).

Pave Penny Pod
- Laser acquisition only device on the A-10.
- Enables the pilot to acquire a laser spot on the ground designated by a ground or an airborne platform (next slide).

LANTIRN (Low Altitude Navigation and Targeting Infrared for Night)
- Consists of two externally mounted pods: a Navigation and a Targeting pod.
- The Navigation pod provides day or night low altitude operation using Forward Looking Infrared (FLIR) and Terrain Following Radar (TFR). FLIR provides unique capabilities for passive navigation and target detection while TFR allows for low altitude navigation and terrain avoidance below cloud decks.
- The Targeting pod allows around-the-clock, beneath cloud, delivery of both conventional and precision guided weapons using laser ranging and designation.
- Reduces pilot workload through presentation of integrated flight symbology, radar cautions and warnings, and FLIR video on the Head-Up Display (HUD).
- Built for the F-16 and F-15E (next slide).

Data Link Weapons

Data link weapons are bombs with either a TV or infrared (IR) camera that provides feedback to the guider. The guider, usually the Weapon Systems Officer (WSO) can transmit signals to the weapon that will more accurately guide the weapon. The bomb will hit whatever the WSO points the bomb at. The CEP for these weapons is 3 meters, and is designed for a high value point target.

GBU-15
- A precision guided standoff weapon.
- Consists of a modular bomb kit attached to a MK-84 or BLU-109 (BLU-109 is a MK-84 with an Improved Penetrator Body.).
- The TV version is day, good weather only. The IR version is day or night, requires good weather, and unusable at thermal crossover.
- Compatible with the F-15E.
- The E-GBU-15 is the same as the GBU-15 except it has a GPS/INS kit that makes the weapon even more accurate (next slide).

AGM-130:

The AGM-130 is a rocket assisted version of the GBU-15 with increased range and stand-off attack capability against high value targets. Just like the GBU-15, it can be attached to either a MK-84 or BLU-109, and either a TV or IR camera.

AGM-142
- Data link standoff missile on the B-52 only. It has either an IR or EO camera with either a 750 or 775 lb warhead.
- GPS/INS aided munitions
- These weapons have a Global Positioning System (GPS) and/or an Inertial Navigation System (INS) computer system than guides the weapon to a pre-determined coordinate. Depending on the bomb/aircraft, the target coordinates are entered into the bomb before takeoff or in flight. After the weapon is released, the computer will pick up GPS signals, or rely on the INS to determine where the weapon is located. The computer will then guide the weapon to the target coordinates. No terminal guidance is needed. GPS/INS aided munitions get around the weather limitations on laser guided munition. GPS/INS aided munitions are designed to go against stationary point targets (next slide).

Conventional Air Launched Cruise Missile (AGM-86)
- These missiles are lauched from a B-52, which can carry 20 of them. The missiles have a 3000lb warhead designed to produce blast effects. Combined with the B-52's range, these missiles can hit

almost anywhere in the world. The CEP for this bomb is around 13 meters if the bomb can pick up the GPS signals, and 30 meters if it relies on the INS. Newer improved versions will be coming out in the future.

Joint Direct Attack Munition (JDAM, GBU-31, 32)

JDAM is an INS/GPS guidance kit added to a MK-83, 84, or BLU-109. The JDAM kit receives position and targeting updates from the aircraft prior to release, and after release will guide the bomb to the desired impact coordinate. CEP for this bomb is around 13 meters if the bomb can pick up the GPS signals, and 30 meters if it relies on the INS. Also, each bomb can have different target coordinates, so multiple targets can be hit from only using a single pass. A MK-83 with JDAM will be called GBU-31, and a MK-84 with JDAM will be called GBU-32. JDAM is operational on the B-2, B-1, and the B-52. Certain blocks of the F-16 will be JDAM capable in the summer of 2000, and other fighters will reach initial operational capability after that. JDAM does not change to the effects of the bomb. The JDAM will have the same effects as the bomb the JDAM kit is attached to. JDAM's range is slightly more than that of Laser Guided Bombs (next slide).

Joint Standoff Weapon (JSOW) (AGM-154)

The Joint Standoff Weapon is a thin bomb body with wings, fins, and a GPS/INS guidance kit. The bomb does not have a motor, but its aerodynamic qualities give it an extended range of more than 25 Nautical Miles. The effects of the JSOW is determined by the sub-munitions contained in the bomb body. Presently, the JSOW can carry either the submunition found in the CBU-87, or CBU-97, or a 500lb penetrator.

Cluster Munitions – (Slides 17 – 21)

CBU-52, CBU-58, CBU-71:
- CBU = SUU (Suspension Unit) + BLU (Bomb Live Unit or bomblets).
- CBU-52 = SUU-30 + 220 softball size BLU-61. (Anti-personnel and material.)
- CBU-58 = SUU-30 + 650 baseball size BLU-63. (Anti-personnel and material.)
- CBU-71 = SUU-30 + 650 baseball size BLU-86. (Random delayed detonation for area denial.)
- BLU-61/63 are spin armed and detonate on impact.
- BLU-86 bomblets are similar to BLU-63 and have a mix of instantaneous and random time delays for detonation.
- BLU-61/63/86 are primarily fragmentation weapons with some incendiary capability. Excellent against soft or thin-skinned targets.

These weapons are for use against area targets. CBU 52/58/71 is now out of the Air Force inventory, but NATO/Coalition countries may still use these weapons. The dud rate on CBU 52/58/71 is high, so EOD is a problem with these weapons (next slide).

Rockeye (MK-20):
- Cluster munition effective against armor as well as personnel.
- Consists of 247 bomblets in a MK 7 dispenser.
- Bomblet has primarily an anti-armor function but does produce some fragmentation. MK-20 is out of the Air Force inventory, but the British still use a BL-755 weapons that is very similar to the MK-20.

Combined Effects Munition (CEM, CBU-87):
- Cluster munition designed to eventually replace the Rockeye and CBU-58.
- Called Combined Effects Munition because of improved effects in incendiary, fragmentation, and armor piercing capabilities (something for everyone).
- Consists of 202 submunitions in a tactical munitions dispenser (TMD) (next slide).

Gator Munition System (CBU-89):
- Cluster munition consisting of a combination of anti-armor and antipersonnel mines delivered in a TMD.
- Similar to artillery Family of Scatterable Mines (FASCAM).
- Arming of the mines is initiated upon their release from the dispenser. They are then aerodynamically dispersed, coming to rest with the arming completed.
- Mines are equipped with self-destruct timers.

Sensor Fused Weapon (SFW, CBU-97):
- The first smart submunition incorporated into a cluster weapon designed to defeat armored targets from above using IR sensors, delivered in a Tactical Munitions Dispenser. This weapon has reached initial operational capability in fighters.
- Consists of 10 BLU-108/B submunitions, with 4 anti-armor warheads (skeets) each. Each submunition disperses its skeets sequentially in an "X" pattern, with its IR sensors spinning and scanning a large elliptical area over the targets.
- A single skeet covers a search area of approximately 100 x 300 feet. The scan pattern of all 40 skeets from a single CBU-97 will describe a search pattern 1200' long and 700' wide.
- The IR sensor in the skeet fires a high velocity Explosively Forged Penetrator against the target's heat source or engine. If no target is found, it fires 8 seconds after release (next slide).

Wind Corrected Munitions Dispensor (WCMD, CBU-103, 104, 105)

WCMD is an inertial guidance kit added to the tail of the CBU-87, 89, and 97. CBU 87, 89, and 97 with the WCMD tail kit will be called CBU-103, 104, and 105. CBUs are inaccurate from medium altitude deliveries because of the poor ballistics in the CBU cannister. WCMD corrects these errors by receiving positional and targeting updates from the aircraft before release, and guiding the CBU to the target coordinates. CEPs of 10-20 meters can be expected from WCMD. IOC for fighters and bombers is scheduled for 2001 and beyond. The effects of WCMD is the same as the CBU the WCMD kit is attached.

Risk-Estimate Distances – (Slides 21 - 22)

Risk-estimate distances are based on the following assumptions. Any changes to the assumptions will increase the risk-estimate distances from those given in the previous table. Risk-estimate distances allow the ground forces commander or the combat air commander to estimate the risk in terms of the percent of friendly casualties that may result from an air strike against the enemy along the forward line of own troops (FLOT). The distances are based on fragmentation patterns.

Computations

All attacks are parallel to the FLOT. Distances are computed from the intended impact point of the center of a stick of bombs. Deflection distance (from the aiming point toward the friendly troops) is built into the risk-estimate distance. The deflection distance equals the distance from the aircraft centerline to the farthest outboard station, plus the lateral distance a weapon travels due to of rack-ejection velocity. **RISK-ESTIMATE DISTANCES ARE FOR COMBAT USE AND ARE NOT MINIMUM SAFE DISTANCES FOR PEACETIME TRAINING USE.** Peacetime minimun numbers are in ACCR 55-26.

Relationships Between Weapon Impact And Point Of Intersection

For all determinations in the table, the position of a prone man was assumed to be on a line perpendicular to the line of flight (or line of weapons impacts) at the midpoint of the line (stick) of weapons. For all sticks of the weapons, a weapon was assumed to impact at the point of intersection of these two lines. Thus, for the weapons evaluated, the following relationships between weapon impact and the point of intersection was assumed:
- GP bombs - center bomb of stick impacts at point of intersection.
- Cluster weapons - pattern center of the center dispenser.
- Guns - center of pattern.
- Maverick - single-weapon delivery impacting at point of intersection.

Casualty Criterion (next slide)

The casualty criterion is the 5-minute assault criterion for a prone soldier in winter clothing and helmet. The probability of incapacitation (PI) means a soldier is physically unable to function in an assault within a 5-minute period after an attack. The 0.1 percent PI value can be interpreted as being less than or equal to one chance in a thousand.

Troops In Contact

The FAC should regard friendlies within 1 kilometer of targets as ***troops-in-contact*** and advise the ground commander accordingly. The ground commander must accept responsibility for friendly risk when targets are inside 0.1 percent PI. The passing of the ground commander's initials indicates his acceptance of the risk for intentional ordnance delivery inside the 0.1 percent PI distance.

Targets/Weapons Summary (Inventory Weapons Only) – (Slide 23)

TARGETS	WEAPONS
Airborne Aircraft	AIM-7/AIM-9/AIM-120 20 mm/30 mm Guns
Armor	MK 20 Rockeye AGM-65 Maverick 30 mm (GAU-8) 40 mm/105 mm (Gunship) CBU-87, 103 CEM CBU-89, 104 Gator Mines CBU-97, 105 SFW
Area Denial and Channelization	CBU-89, 104 Gator Mines CBU-71 (Random fusing BLU-86 bomblets) MK-36 Destructor on MK-82 Snakeye
"Soft" Targets (Personnel, trucks, radar, aircraft parked, etc.)	GP Bombs CBU-52/58/71 CBU-87, 103 CEM 20 mm/30 mm (API/HEI) 25 mm/40 mm/105 mm (Gunship)
Point Targets	LGBs (GBU-10,-12,-14,-24,-28,-31,-32) AGM-65 Maverick GBU-15/AGM-130 20 mm/25 mm/30 mm/40 mm Guns AC-130 105 mm cannon
Hardened Targets	GP bombs with steel nose plugs BLU-109 LGBs (GBU-10,-12,-14,-24,-28,-31,-32) AGM-65 Maverick GBU-15/AGM-130 105 mm Howitzer (Gunship)
SAM and AAA sites (radar only)	Anti-Radiation Missiles

Additional Weapons Information

TARGET	RECOMMENDED ORDNANCE	FUZING
1. PERSONNEL		
a. In Open	Cluster Weapons (CBU-52, 58, 71, 87)	V.T.
	General Purpose Bombs (MK-81, 82, 83, 84)	Instantaneous
	HE Gun Projectiles (20, 25, 30, 40mm)	HEI
	2.75 FFAR w/FAR (Flechettes, M151)	
b. In Fighting Holes	Cluster Weapons (CBU-52, 58, 71, 87)	
	Fuel-Air-Explosives (FAE)	
	General Purpose Bombs	
	2.75 FFAR w/FAR (Flechettes, M151)	
c. Under Light Cover	General Purpose Bombs	
	Rockets (2.75"FFAR w/Armor Piercing Warhead)	
	Armor Piercing Gun Projectiles	API
	Cluster Weapons (Shaped Charge: CBU-87, MK-20 Rockeye)	
d. Under Heavy Cover (Concrete Bunkers)	General Purpose Bombs (MK-84 w/Steel Nose Plug in Low Drag Configuration)	Delay
	Laser Guided Munitions (GBU-10, 24, 28)	Delay
	EO/IR Guided Munitions (AGM-65G, GBU-15, AGM-130)	Delay
2. ARMORED VEHICLES (Tanks, APCs & Mobile Assault Guns)	General Purpose Bombs	Near direct hit
	Cluster Weapons (CBU-87, CBU-89, CBU-97 SFW, MK-20 Rockeye)	
	Laser Guided Munitions (GBU-10, 12, 24)	
	EO/IR Guided Bombs (GBU-15, AGM-130, AGM-65A/B/D/G)	AGM-65D Delayed
	2.75" FFAR (Armor Piercing Warhead)	
	Armor Piercing Gun Projectiles	API

TARGET	RECOMMENDED ORDNANCE	FUZING
3. FIELD ARTILLERY		
a. In Open	Cluster Weapons (Frag and Shaped Charge) General Purpose Bombs Laser Guided Munitions (GBU-10, 12, 24) EO/IR Guided Bombs (GBU-15, AGM-130, AGM-65A/B/D/G) HEI/API HE Gun Projectiles	Instantaneous HEI
b. In Revetments	Cluster Weapons (Shaped Charge) General Purpose Bombs Laser Guided Munitions (GBU-10, 12, 24) EO/IR Guided Bombs (GBU-15, AGM-130, AGM-65A/B/D/G)	 Airburst
c. In Covered Positions	General Purpose Bombs Laser Guided Munitions (GBU-10, 12, 24) EO/IR Guided Bombs (GBU-15, AGM-130, AGM-65A/B/D/G)	Delayed
4. ANTIAIRCRAFT ARTILLERY		
a. Automatic	Same as 3. with following addition: Firebombs	
b. Self-Propelled	Same as 2.	
5. ROCKET LAUNCHERS	Cluster Weapons (CBU-87, MK-20 Rockeye) General Purpose Bombs Laser Guided Munitions (GBU-10, 12, 24) EO/IR Guided Bombs (GBU-15, AGM-130, AGM-65A/B/D/G) HE/Armor Piercing Gun Projectiles	 Instantaneous or Delay API/HEI

TARGET	RECOMMENDED ORDNANCE	FUZING
6. MISSILE SITES		
a. Surface-to-Air Missiles	Antiradiation Missiles (AGM-88) Followed by Cluster Munitions Retarded GP Bombs (BSU-49/50) General Purpose Bombs Laser Guided Munitions (GBU-10, 12, 24) EO/IR Guided Bombs (GBU-15, AGM-130, AGM-65A/B/D/G)	Instantaneous Instantaneous or Delay
b. Surface-to-Surface Missiles	Same as 2. with the following additions: Cluster Weapons (Shaped Charge) Followed by Incendiary Weapons or Firebombs General Purpose Bombs Laser Guided Munitions (GBU-10, 12, 24) EO/IR Guided Bombs (GBU-15, AGM-130, AGM-65A/B/D/G)	
7. RADAR INSTALLATIONS	Antiradiation Missiles (AGM-88 HARM) Cluster Weapons (Frag or Shaped Charge) Laser Guided Munitions (GBU-10, 12, 24) EO/IR Guided Bombs (GBU-15, AGM-130, AGM-65A/B/D/G) General Purpose Bombs HE/Armor Piercing Gun Projectiles Fuel-Air-Explosive (FAE)	 Instantaneous or Delay HEI/API
8. FIELD FORTIFICATIONS	General Purpose Bombs Laser Guided Munitions (GBU-10, 12, 24) EO/IR Guided Bombs (GBU-15, AGM-130, AGM-65A/B/D/G)	

TARGET	RECOMMENDED ORDNANCE	FUZING
9. SUPPLY DEPOTS OR DUMPS		
a. Stacked Ammo	Shaped Charge Weapons (CBU-87, MK-20) Fire & Incendiary Weapons Large Blast/Frag Weapons (MK-84)	
b. POL Storage Drums	Large Blast/Frag Weapons (MK-84, BLU-109) Large Shaped Charge Weapons (AGM-65) General Purpose Bombs Cluster Weapons (CBU-52, 58, 71, 87, MK-20)	
c. POL Underground	General Purpose Bombs (MK-84 or BLU-109 w/steel nose and low drag fins)	Delay
10. LAND TRANSPORTATION		
a. Roads	General Purpose Bombs (MK-82/84)	Delay
b. Trucks	Cluster Weapons (CBU-52, 58, 71, 87, MK-20) Incendiary or Firebombs General Purpose Bombs (MK-82/84) Laser Guided Munitions (GBU-10, 12, 24) HE/Armor Piercing Projectiles (Strafe)	 HEI/API

TARGET	RECOMMENDED ORDNANCE	FUZING
11. LAND TRANSPORTATION (continued)		
c. Railways		
- Track	General Purpose Bombs (MK-82/84) Land Mines (CBU-89)	Delay
- Rolling Stock	General Purpose Bombs (MK-82/84) Laser Guided Munitions (GBU-10, 12, 24) EO/IR Guided Bombs (AGM-65A/B/D/G) Incendiary Weapons	Instantaneous or Delay
- Locomotives	Cluster Weapons (CBU-87, MK-20) General Purpose Bombs (MK-82/84) Laser Guided Munitions (GBU-10, 12, 24) EO/IR Guided Bombs (AGM-65A/B/D/G) HE/API Gun Projectiles	 HEI/API
12. WATER TRANSPORTATION		
a. Inland Canals	General Purpose Bombs (MK-82/84) Demolition Bombs Penetration PGMs (GBU-28)	Delay Delay
b. Junks & Sampans	General Purpose Bombs Laser Guided Munitions (GBU-10, 12, 24) EO/IR Guided Bombs (AGM-65A/B/D/G) HE/API Gun Projectiles	Delay
c. Barges & Small Craft	General Purpose Bombs Laser Guided Munitions (GBU-10, 12, 24) EO/IR Guided Bombs (AGM-65A/B/D/G)	Delay
13. BUILDINGS	General Purpose Weapons PGMs (Shaped or Large Warhead) Incendiary Weapons	Delay

GENERAL PURPOSE MUNITIONS SUMMARY				
GP BOMB	**TOTAL WEIGHT (lb)**	**EXPLOSIVE WEIGHT (lb)**	**COMPATIBLE FUZES**	**OPTIONS/ REMARKS**
MK-82	531	192	MK-904 (Nose) MK-905 (Tail) FMU-26B/B (N/T) FMU-139A/B (N/T) FMU-113/B (Nose)	M1A1 Extender ATU-35 Drive 15 ft Airburst
MK-82SE	570	192	FMU-54 (Tail) FMU-139A/B (N/T) FMU-113/B (Nose) MK-904 (Nose) FMU-26 B/B (Nose)	 15 ft Airburst
BSU-49	550	192	Same as MK-82SE	
MK-84	1972	945	Same as MK-82	
BSU-50	2020	945	Same as MK-82SE	Min Del A/S = 550 KCAS w/FMU-54, 450 KCAS w/FMU-139
BLU-109/B (I-2000)	1925	550	FMU-143/B (Tail) w/ FZU-32B/B Initiator	MK-84 Class, Penetrating Case

CLUSTER MUNITIONS SUMMARY							
CBU TYPE	**DISP TYPE**	**SUB-MUNITION**	**BOMBLET SIZE**	**# OF**	**FUNCT TIME**	**INCEN?**	**KILL MECH**
52B/B	SUU-30	BLU-61A/B	SOFTBALL	220	IMPACT	YES	FRAG
58B	SUU-30	BLU-63/B	BASEBALL	650	IMPACT	NO	FRAG
58A/B	SUU-30	BLU-63A/B	BASEBALL	650	IMPACT	YES	FRAG
71/B	SUU-30	BLU-86/B	BASEBALL	650	RANDOM	NO	FRAG
71A/B	SUU-30	BLU-86A/B	BASEBALL	650	RANDOM	YES	FRAG
87/B	SUU-65	BLU-97/B	BEER CAN	202	IMPACT	YES	FRAG/ SHAPE
89	SUU-64	BLU-91/92	5” MINE	72/22	SENSOR	NO	MINE
97	SUU-66	BLU-108	TREE w/SKEET	10 tree/ 40 skeet	SENSOR	NO	SHAPE PROJ
MK-20	MK-7	MK-118	LAWN DART	247	IMPACT	NO	FRAG/ SHAPE

PRECISION GUIDED MUNITIONS SUMMARY					
DESIGNATION	**WARHEAD**	**COMPUTER**	**TYPE**	**WEAPON WT (LB)**	**OPTIONS/ REMARKS**
GBU-10/B	MK-84	MAU-157/B	LGB	2052	Paveway 1
GBU-10A/B	MK-84	MAU-157A/B	LGB	2052	Paveway 1
GBU-10H/B	BLU-109/B	MAU-169A/B	LGB	2127	Paveway II,
GBU-10J/B	BLU-109/B	MAU-169B/B MAU-169D/B	LGB	2127	Paveway II
GBU-10E/B	MK-84	MAU-169B/B MAU-169D/B	LGB	2081	Paveway II
GBU-12/B	MK-82	MAU-157/B	LGB	600	Paveway 1
GBU-12A/B	MK-82	MAU-157A/B	LGB	600	Paveway 1
GBU-12B/B	MK-82	MAU-169/B	LGB	610	Paveway II
GBU-12C/B	MK-82	MAU-169A/B	LGB	610	Paveway II
GBU-12D/B	MK-82	MAU-169B/B MAU-169D/B	LGB	610	Paveway II
GBU-15(V)1/B	MK-84	DSU-27A/B (EO) WGU-10/B (IR)	EOGB, IRGB	2510	AXQ-14 Data Link Pod
GBU-15(V)2/B	BLU-109/B	DSU-27A/B (EO) WGU-10/B (IR)	EOGB, IRGB	2556	AXQ-14 Data Link Pod
GBU-24A/B	BLU-109/B	WGU-12B/B WGU-39/B	LLLGB	2372	
GBU-24/B	MK-84	WGU-12B/B WGU-39/B	LLLGB	2256	
GBU-28	BLU-113/B	WGU-36/B	HTLGB	4500+	Paveway III Hard Target
AGM-65A	125 LB SC	B on W/W on B	EO	464	Shaped Charge
AGM-65B	125 LB SC	B on W/W on B	EO	464	Same as A
AGM-65D	125 LB SC	Hot on Cold/ Cold on Hot	IIR	500	Same as A
AGM-65G	300 LB BF	Hot on Cold/ Cold on Hot	IIR	672	Blast/Frag
AGM-130A-1,2,3,7,8	MK-84	DSU-27B/B WGU-33A/B (IR) WGU-40/B (TV) WGU-42/B (IR)	EOGB/ IRGB	2980 (A-1) 3021 (A-2)	Rocket assist WPU-9/B
AGM-130C-1,2,3,7,8	BLU-109/B	Same as AGM-130A	EOGB/ IRGB	NA	Rocket assist WPU-9/B

MAXIMUM BOMB FRAGMENTATION TRAVEL						
	Altitude (ft)		Horizontal (ft)		TOF (sec)	
MUNITION	Sea Level	5000' MSL	Sea Level	5000' MSL	Sea Level	5000' MSL
UNITARY WARHEADS						
MK-82 GP (All types)	2140	2500	2550	2900	24.4	25.9
MK-84 GP (All types)	2770	3150	3260	3715	28.0	29.7
BLU-109 (All types)	3465	3915	4230	4795	30.3	32.1
INTACT CLUSTERS						
CBU (SUU-30)	1895	2140	2290	2595	23.0	24.4
CBU-87 (SUU-65)	1895	2140	2290	2595	23.0	24.4
MK 20 (MK-7)	1380	1575	1645	1850	19.4	20.6
CLUSTER SUBMUNITIONS						
BLU 61 A/B (CBU-52)	665	755	775	880	14.2	15.0
BLU 63/B (CBU-58/B)	430	490	490	560	11.6	12.3
BLU 86/B (CBU-71/B)	430	490	490	560	11.6	12.3
BLU 97/B (CBU-87/B)	545	620	635	725	12.8	13.7
MK 118 (MK 20 Rockeye)	695	790	800	915	14.7	15.5

AIR INTERCEPT MISSILES SUMMARY		
TYPE	**DESIGNATION**	**WARHEAD**
1. AIR INTERCEPT MISSILES		
a. Active Radar	AIM-54 Phoenix	Blast Frag
	AIM-120 Advanced Medium Range Air-to-Air Missile (AMRAAM)	Blast Frag
b. Semi-Active Radar	AIM-7F Sparrow	Continuous Rod
	AIM-7M Sparrow/AIM-7M (H-Build)	Blast Frag
c. Infrared	AIM-9L/M Sidewinder	Annular Blast Frag

RISK-ESTIMATE DISTANCE FOR AIRCRAFT-DELIVERED ORDNANCE:
(NOTE - This data is NOT for peacetime training. These distances are for wartime use only.)

		Risk-Estimate Distance (m)	
ITEM	**DESCRIPTION**	**10% PI**	**0.1% PI**
MK-82 LD	500-LB General Purpose Bomb	250	425
MK-82 HD	500-LB General Purpose Bomb (BSU-50)	100	375
MK-82 LGB	500-LB General Purpose Bomb (GBU-12)	250[1]	425[1]
MK-83 LD	1000-LB General Purpose Bomb	275	475
MK-83 HD	1000-LB General Purpose Bomb (Retarded)	275	475
MK-83 LGB	1000-LB General Purpose Bomb (GBU-16)	275[1]	475[1]
MK-84 LD	2000-LB General Purpose Bomb	325	500
MK-84 HD	2000-LB General Purpose Bomb (BSU-49)	325	500
MK-84 LGB	2000-LB General Purpose Bomb (GBU-10/22)	225[1]	500[1]
MK-20[2]	Rockeye w/247 Mk 118 Bomblets	150	225
CBU-52[2]	Cluster Munition w/220 BLU-61	275	450
CBU-58/71[2, 3]	Cluster Munition w/650 BLU-63/86	350	525
CBU-87[2]	Combined Effects Munition w/202 BLU-97	175	275
CBU-89[2, 3]	Gator w/72 BLU-91 & 22 BLU-92	175	275
M61	20mm Gatling Gun (e.g. F-15E, F-16)	100	150
GAU-8	30mm Gatling Gun	100	150
AGM-65[4]	Maverick (TV, IIR, Laser)	25	100
105mm	Cannon AC-130H/U Gunship	500[5]	500[5]

Notes:
PI = Probability of Incapacitation, m = meters, HD = high drag, LD = low drag,
LGB = laser-guided bomb, IIR = imaging infrared
1 = Risk-Estimate distances are to be determined. For LGBs, the values shown are for weapons that do not guide and that follow a ballistic trajectory similar to GP bombs.
2 = Not recommended for use near troops in contact.
3 = CBU-71 bombs contain time-delay fuses that detonate at random times after impact. CBU-89 mines (anti-tank, anti-personnel) are not recommended for use near troops in contact.
4 = Data listed applies only to AGM-65A, B, C, and D models. Models E and G contain a larger warhead and risk-estimate distances are not currently available.
5 = Distance used for all AC-130 engagements as it has the largest fragmentation pattern for the largest weapon system on board.

The Web Site. www.fas.org/man has a lot of information about weapon systems and airplanes.

Conclusion – (Slide 24)

This class provides the student with knowledge of USAF aircraft weapon characteristics, capabilities and limitations. For a more indepth study of aircraft munitions, reference the require reading material or visit the CAS home page on the World Wide Web at at wwwmil.acc.af.mil/cas/.